

Weathering the STORM(WATER) IN CAPE TOWN

Sue Matthews

Managing stormwater in an urban environment is challenging for any city. Sue Matthews looks at the City of Cape Town's approach to water-sensitive urban design.

Landscape architects, town planners, civil engineers and environmental practitioners responded so positively to an invitation to the City of Cape Town's presentation on its new stormwater, catchment and river management policies that a second presentation had to be scheduled to accommodate them all.

The two policies – approved by Council in May 2009 – build upon guidelines on stormwater management and floodplain management published in 2002 and 2003 respectively. The Floodplain and River Corridor Management Policy promotes an approach for dealing

with development proposals adjacent to watercourses and wetlands, taking into account the risk of flooding as well as ecological and socio-economic considerations. It recognises that urban waterbodies are an integral part of the stormwater system, and that even those that have been canalised or constructed play an important role in sustaining flows to aquatic ecosystems downstream, while also having significant recreational and aesthetic value for the city's inhabitants.

"By dealing with runoff and pollution on site, sustainable urban drainage systems can help lower flow rates, improve water quality, increase groundwater recharge and create a 'greener' environment for wildlife and local residents."

In terms of the policy, no development will be permitted in the high hazard zone of a floodplain, closest to the watercourse, nor

will obstruction to the free flow of water be allowed within the 20-year floodline. Some developments or activities may be permitted between the 50 and 100-year floodlines, but buildings with special evacuation or emergency response concerns, such as senior citizen centres, hospitals, schools, chemical plants – and even halls that may be needed to accommodate evacuees in an emergency – will only be allowed above the 100-year floodline.

In addition, ecological buffers will be maintained to provide habitat for fauna and flora, reduce erosion and protect waterbodies from

polluted runoff, while also enhancing the urban landscape. The buffer and adjacent area set aside for socio-economic use, as well as the watercourse and associated wetlands, will comprise the river corridor, which will be managed in an integrated manner that balances the flooding, environmental and socio-economic issues.

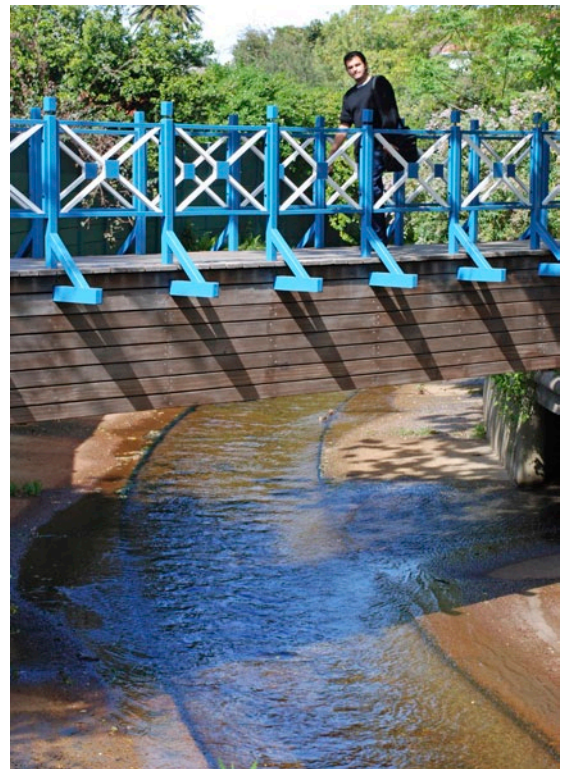
"The City will be developing river corridor plans to give effect to this," explained Martin Thompson, of the City of Cape Town's Roads and Stormwater Department. "We shouldn't work in isolated fragments where we look only at a particular development or river reach."

While the above policy aims to control development alongside watercourses, the Management of Urban Stormwater Impacts Policy focuses on minimising the impact of stormwater from developed areas on watercourses, wetlands and other receiving waters. It recognises that

urbanisation negatively impacts waterbodies by hardening surfaces and accelerating stormwater runoff, which reduces groundwater recharge and increases erosion, apart from causing a deterioration in water quality, ecosystem integrity and biodiversity.

The policy is therefore based on the principles of Water Sensitive Urban Design (WSUD), an internationally accepted approach to ensure urban development is planned, designed, constructed and maintained in a way that will help reduce negative impacts on the natural water cycle and protect aquatic ecosystems.

"Although the guidelines for new developments published in 2002 looked at both quantity and quality of runoff, the quality aspects were largely ignored, and were not specific enough," said Rod Arnold, also of the City of Cape Town's Roads and Stormwater Department. "We therefore decided to develop policy, which



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THE CENTURY CITY SUDS SYSTEM

The Century City sustainable urban drainage system collects stormwater runoff from the surrounding area and 'polishes' it in a constructed wetland consisting of four ponds with different functions.

Ponds 1 and 2 have reed beds that not only slow the flow of water, encouraging settling of suspended particles, but also take up phosphate from the polluted stormwater. Pond 3 has a large expanse of deep open water that is aerated by the wind, allowing bacteria that break down nitrogenous compounds to flourish.

Pond 4 is a shallow pond that is well aerated and densely vegetated, facilitating removal of residual phosphates and nitrates. The constructed wetland and natural, seasonal pans adjacent to it are important bird habitat, while the canals provide recreational opportunities.



The City of Cape Town's new River Corridor Management Policy recognises that even canalised rivers may have recreational and aesthetic value for the city's inhabitants. A popular walking trail follows the Liesbeek River as it flows through Rondebosch and Rosebank.

is given legal teeth by the by-law promulgated in 2005."

The City of Cape Town's by-law relating to stormwater management prohibits discharge of anything other than stormwater into the stormwater system, and also outlines measures to protect the stormwater system from damage, pollution and flooding. The new policy goes a step further, aiming to improve the quality of runoff by specifying a pollutant removal target of an 80% reduction in suspended solids and a 45% reduction in total phosphorus. It also stipulates measures to protect against erosion and flooding. These are contained in an annexure to the policy entitled 'Interim criteria for achieving Sustainable Urban Drainage System objectives in various development scenarios'. Sustainable Urban Drainage Systems – commonly known as SUDS – is the component of Water Sensitive Urban Design focusing on stormwater management.

Following Rod Arnold's presentation, Prof Neil Armitage of the University of Cape Town's Civil Engineering Department gave a

presentation on the SUDS approach, which attempts to replicate natural drainage rather than carrying stormwater away in pipes and canals as quickly as possible. By dealing with runoff and pollution on site, SUDS can help lower flow rates, improve water quality, increase groundwater recharge and create a 'greener' environment for wildlife and local residents. This is achieved with permeable surfaces such as gravel, kernel or wood chip; infiltration devices that drain water directly into the ground; filter strips and swales – vegetated slopes and channels that slow the flow of runoff – as well as detention ponds and artificial wetlands containing reeds and other riparian plants.

Prof Armitage is currently the project leader of a WRC-funded project entitled Alternative Technology for Stormwater Management, which aims to identify, develop and evaluate WSUD technologies for use in South Africa, and compile practical and user-friendly guidelines for their implementation. The research team consists of the Urban Water Management Group at UCT – a multidisciplinary group that includes researchers from the Civil Engineering, Environmental and Geographical Science, and Social Anthropology departments, among others – as well as representatives from the municipalities of Cape Town, Durban (eThekweni),



Johannesburg and Pretoria (Tshwane), SRK Consulting Engineers and IDS (Information Decision Systems).

One of the project deliverables that has already been completed is a report showcasing a number of existing SUDS-type developments in South Africa. Examples include Century City's canals and wetlands in Cape Town, the University of Witwatersrand car parks and the Cotswold Downs golf estate in Durban. Another component of the project is a scientific experiment to investigate how well riparian

Left: The Century City sustainable urban drainage system collects stormwater runoff from the surrounding area and 'polishes' it in a constructed wetland consisting of four ponds.



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to look at it because if you design a swale with natural vegetation it will probably be taken over by kikuyu anyway. *Typha* and *Phragmites* are also highly problematic in eutrophic environments, and they don't offer much in the way of ecological services or habitat."

"The plants are watered with an automatic irrigation system every three days, each with a litre of water simulating the phosphate, nitrogen and ammonia concentrations of different types of water. A third of the plants are dosed with clean water, a third with water representing diluted stormwater, and a third with water typical of extremely polluted runoff. The water that drains through the soil – consisting largely of Malmesbury shale – is collected for laboratory analysis of phosphorus and suspended solids, in line with the City of Cape Town's stormwater policy."

"I'll also have a student modelling in-stream flow of wetlands – probably those at Century City – to look at biological responses to inflows, while another component of the broader project is investigating the 'green roof' concept. Both the Cape Town and eThekweni Municipalities have pilot studies on their own premises, and by getting the municipalities involved as partners in the project we've got them excited about the possibilities."

"We've also drawn in students from a range of different departments at UCT, so we're learning from each other in a cross-disciplinary way. This has helped make us far more critical about the assumptions we make and the way we communicate our research, which has been hugely beneficial."

In light of this progressive approach, it is anticipated that the project – due for completion in 2012 – will contribute to changing thinking and improving practices in managing the drainage of surface water in South Africa. □

plants perform as biofilters.

Dr Kevin Winter of UCT's Environmental and Geographical Science Department heads up this study, which also involves researchers from the Botany and Chemistry Departments.

"The City of Cape Town's policy of an 80% reduction in suspended solids and a 45% reduction in total phosphorus is a bold initiative, and one that I think is very progressive," says Dr Winter. "But technically it's difficult to do – for instance, we don't know what kind of plants would be most effective

as biofilters. There's also a risk that organic pollutants would accumulate in the soil of these biofilters over time, and eventually reach toxic levels."

"So we've set up an experiment in one of UCT's glasshouses with 300 plants of nine different species. These include the *Typha* bulrush and *Phragmites* reed – the two species that dominate wetlands in the Western Cape – as well as two Cape restios, the arum lily, agapanthus, sour fig, and buffalo and kikuyu grass. All are indigenous apart from kikuyu, but we wanted

Above: Dr Kevin Winter of the University of Cape Town's Environmental and Geographical Science Department is project leader for a WRC-funded greenhouse experiment to test the effectiveness of various plant species for use as biofilters.